

## Econophysics

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**Class hours:** 14 two-hours-lectures from Monday 31 January to Friday 18 March 2022.

- Monday 13:45-15:45, room 117 T 33-34
- Friday 8:30-10:30, room 212 T 23-24

**Evaluation** (3 ECTS):

- Financial data analysis report for 20% of the score.
- Bibliographic report (oral presentation) for 20% of the score.
- Final 3-hours exam. (week of 28 March 2022) for 60% of the score.

## Course Description

Economics deals with human activities, such as production, distribution and consumption of wealth. However mainstream economic theory has been driven by general physical concepts, like equilibrium, with the aim of providing scientific basis for its forecasts. Furthermore, economic data stem from the interaction of a large number of agents and therefore call for the tools and ideas of statistical physics. In this course, some basic economic and financial concepts will be first introduced and discussed (no prerequisite is required), in particular the underlying hypothesis which constitute the cornerstones of modern financial theory. We will then investigate the modeling of financial markets from a physics perspective, by using empirical analysis and by comparing the real-life financial data properties with those predicted by models. From the evolution of stock prices as a random walk to the option pricing by the famous Black-Scholes model, the aim of this course is to discuss the validity of modern financial theory and to show to what extent statistical physics allows for a better understanding of financial markets.

## Course Outline

- A What is Econophysics ?
- B A Very Brief Introduction to Financial Markets
- C Derivatives and The Black-Scholes Theory of Option Prices  
(two tutorials)
- D Financial Data and Realistic Modeling  
(two tutorials and a financial data analysis report)
- E From Microscopic to Macroscopic: Agent-Based Models  
(a bibliographic report)

## Readings and learning resources

- *An Introduction to Econophysics: Correlations and Complexity in Finance*, R.N. Mantegna and H.E. Stanley (Cambridge University Press, 1999)
- *The Statistical Mechanics of Financial Markets*, J. Voit (Springer, 2005)
- *Theory of Financial Risk and Derivative Pricing: From Statistical Physics to Risk Management*, J.P. Bouchaud and M. Potters (Cambridge University Press, 2009)
- *A Guided Walk Down Wall Street: an Introduction to Econophysics*, G.L. Vasconcelos: arXiv:cond-mat/0408143
- *The Mathematics of Financial Derivatives: A Student Introduction*, P. Wilmott, S. Howison and J. Dewynne (Cambridge University Press, 1997)
- *Options, Futures and Other Derivatives*, J.C. Hull *et al.* (Pearson 10th edition, 2017)

Nice readings in french:

- *Une approche fractale des marchés*, B. Mandelbrot et R.L. Hudson (Odile Jacob, 2009)
- *Le commerce des promesses : Petit traité sur la finance moderne*, P.N. Giraud (Points Economie, 2009)
- *Une brève histoire des crises financières*, C. Chavagneux (La Découverte, 2011)
- *L'argent*, E. Zola (1891)

Two movies : *Margin Call*, J.C. Chandor (Drama film, 2011) and *Inside Job*, C.H. Ferguson (Documentary film, 2010)